Policy Making Improvement through Social Learning

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Abstract. The world for which policies have to be developed is becoming increasingly complex, uncertain and unpredictable. Citizens are better informed, have rising expectations and are making growing demands for services tailored to their individual needs. The traditional policy-making process – where identification of problems and solutions given are defined by a small group of politicians and experts – is characterized by several inefficiencies: risk of false identification of problems, misled setting of goals, wasted resources, unsatisfactory evaluation and, above all, inefficiently addressed societal problems. The main goal of paper is to address the above mentioned challenges through the exploitation of social learning and supporting ICT techniques for a more efficient and open policy making process. These will enable better motivation to participate by taking each opinion into account for the final solution. The paper discusses our Centralab ICT solution as a supporting environment for policy modeling. The aim of our solution is not to change policy-making processes but rather to support them with innovative ICT tools to reach the overall goal when policy-making results in better quality of democracy and improved civic capacity.

Keywords: e-government, policy modeling, ICT enabled policy making, social learning.

1 Introduction

In the last two centuries the civilized world has fought to institutionalize civil, political, and social rights. In a time of great global transformation the new challenge is to spread and deepen democracy as a way of life. Now, in the early 21st century, participatory democracy [1] is not an alternative to liberal democracy [2] – it is a challenge to it, a deepening and broadening of 'actual existing' democracy.

Nowadays, transparency and participatory democracy become essential to facilitate good governance. By strengthening the relations with citizens and engage them in policy making will contribute to building public trust, raise the quality of policies and politics that will result in better quality of democracy and improved civic capacity.

The traditional policy-making process - where identification of problems and solutions given were defined by a small group - is characterized by several inefficiencies: risk of the false identification of problems is high, setting of goals are mislead,

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resources allocated are wasted and overall the societal problem is not addressed. The role of politicians and selected experts is overrated and the decision making process is not transparent enough and accountability and responsibility have no limitation on attitudes, accountability matters only when elections take place. The stakeholders are only informed at the end of the process.

The weaknesses of the above mentioned practice and the evolution of the society and technology give space for new policy-making procedures where active participation of citizens is a core element. Strengthening the government – citizen relationship is fundamental in order to establish the most suitable policy-making process. Main benefits arising from a well-functioning relationship are:

- improved quality of policies – wider sources of information, perspectives and potential solutions are available
- challenges of the emerging information society - faster interactions and better knowledge sharing and creation are met
- public opinion is integrated in the policy-making process
- citizens' expectations that their voices are heard and views and opinions are considered can be fulfilled, and greater transparency and accountability can be achieved.

These relations cover a broad spectrum of interactions at each stage of policy-making cycle: from the design through implementation to evaluation. These relations can be also analysed from the 'level of interactions' perspective as well [3-6]:

- Information: a one-way relation in which government produces and delivers information for use by citizens.
- Consultation: a two-way relation in which citizens give feedback to government, on prior definition by the government of the issue on which citizen's sought are required.
- Participation: an active relation based on continuous and not limited interactions between citizens and government. This form of collaboration enables citizens to be engaged in policy making process from the proposition of policy options to shaping the policy dialogue.

ICT has an outstanding potential to support new policy-making practices. While there is legal background and established mechanisms supported by ICT tools as well for information (e.g. portals and websites) and consultation (e.g. opinion polls and surveys) there are only a few experiments and pilots with ICT tools to engage actively the citizens in policy making. The dynamism of the policy modeling landscape point of view is aroused from the two competing legs of ICT support. On one hand the ICT infrastructure is developing, growing as broadband access penetration, new and powerful mobile devices, etc. On the other hand the application development is trying to keep up with the new opportunities (e.g. social media hype, cloud services, etc.). For policy modeling this competition gives always renewed opportunity to introduce new and new services. Looking back only one-two decades, the renewal cycles repeats each other in fairly short cycle times.

From application point of view also characteristic levels of development can be distinguished [3]. ICT enabled policy making might start with the one-way information, which is extended with very limited opinion articulation opportunities (mostly in the form of comments). This solution is a combination of informing and "water cooler", giving a surface for presenting opinion of citizens (any many cases dominated by certain subcultures). Stepping ahead the social consultation already takes in to account what are the distribution of the opinions in the sense of agree/disagree. Advanced sentiment analysis may calculate the degree of agree/disagree or like/dislike. On a more advanced level, we might call social dialogue [7], not only the articulation of opinions is in the focus, but searching for consensus. In policy making normally policy makers look for the good (optimal) solution, where optimum means the best compromise among the particular interests. The particular interests should be well articulated, argued in order to reach sufficient solution. There are many precondition can be mentioned at this level, but definitely one of the most important whether the participants, stakeholders are being well-informed, and having the sufficient knowledge concerning the policy in matter. The main benefits can be achieved at this level is the increased awareness, high level of inclusion by participation on the top of these the higher level of motivation. As a perspective, the next level can be the social learning. Social learning is assumed when individuals assimilate new information and apply it to their subsequent actions [8]. And it is considered as a deliberate attempt to adjust the goals and techniques of policy in response to past experience and new information. Learning is indicated when policy changes as the result of such a process. Milbrath [9] used 'self-educating community' expression to describe situation where people learn from each other and from the environment, he was one of the first author who linked the term social learning to sustainable development.

The process and quality of policy-making affect the citizens at several points during the course of the execution. The inclusion of citizens is nowadays a focal point in policy-making, especially together with preliminary impact analysis. Current policy-making practice suffers from several problems which undermine the productive operation of the process. The concept of interactive policy-making is a significant step to broaden the inclusion of citizens, as well as to support preliminary impact analysis. The method can be promoted by several ICT tools and methodologies.

Social media and a variety of participatory tools have become popular (web/text/opinion mining, online social networking, blogs, wikis, and forums). Using these tools public administration decision-makers, governance bodies and civil society actors have the possibility of bringing about significant changes in the way future societies will function. The emerging technological environment has dramatic impact on communication, information processing and knowledge-sharing among public administration participants and also within civil society. Participatory democracy can be approached by developing IT based channels for a clear voicing of opinions, expression of citizens' needs and a extension of participation. In this new setting, decision makers have access to a large amount of data and information concerning people's situations, what they think and what they believe. In the paper we address those problems which are related to the enhancement of knowledgeable policy modeling, decision support and decision making through social learning.

In policy making context the complex, fragmented nature and the immense quantity of data can cause several problems. To align public policies with emerging societal needs, requirements and expectations, policy-makers need feedback on their initiatives. Civil society requires transparency of the policy-making process. Importance of ICT and especially social media as tools enabling transparent, open and accessible information services was discussed by [10] and Jaeger and Bertot [11-12]. Gelders and Rijnja [13] have looked at external, public communication-related issues of policy-preparation stages (policy intention), emphasizing the importance of proactive and interactive communication with the citizen while realizing that successful interaction between communication professionals and policy professionals is critical for any successes, too. Risk is an inherent part of the policy life-cycle, and frameworks have been developed to take on board the risk aspects of e-government initiatives [14].

Optimal utilization of ICT for policy modeling raises several questions [15].One of the main challenges here is how to cope with a large volume of data and the time constraint against data processing. Questions related to our research as well are: How can we manage interaction and coordination in relation to civil society agents that might exploit this data? How can we facilitate communication and knowledge sharing so that it is not overly time-consuming, whilst avoiding information overload? How can we dig out the collective intelligence of different stakeholders, orient this so as to augment our ability to identify trends, and then find solutions? How can we rest assured that this flow of information is reaching the right government agencies or decision-makers? For in this regard it is essential to know that the right information goes to the right (i.e. competent) body, institution or person.

Innovative ICT solutions especially social media and web 2.0/web 3.0 solutions provide a new way for capturing those issues, problems, which require immediate actions in terms of new policies, or management of existing one. One of the main goal of our research is to explore and monitor the mid-term impacts of policy decisions, in their maximum complexity. Maximum complexity means the articulation of all the relevant arguments, viewpoints and their interdependences regarding the policy in question. Impact amongst others, can be captured through the “voice of citizens” by an online environment and serves as an additional input for fine-tuning decisions through the modeling. Feedback collected can be pre-processed with the data and text mining tools, in order to filter and aggregate stakeholders’ opinion for the modeling and to modify model variables if it is needed. Finally, by using advanced visual analytics methods, our approach enables continual monitoring of a policy impact, providing a useful mechanism for managing the risk in policy implementation, especially in dynamically changing environments. Fast changes in the environment, as well as the instability and interconnectivity makes policy making challenging nowadays. ICT tools can promote the policy modeling process, giving supportive methods to design, implement and evaluate policies. The process of interactive policy-making can be supported by several ICT tools and methodologies. Promotion can be used at the design, implementation and evaluation process steps as well [16-17]. This paper will be structured as follows:

First, policy modeling and policy making -related problems and challenges are discussed from social learning aspect, then, theoretical background are detailed.

The following part presents our ICT solution for policy making improvement through social learning. Finally, conclusion part summarizes strengths and weaknesses of our approach with further improvement directions.

2 The State of the Art in Policy Modeling and Governance

Several approaches are discussed in the literature for policy-making [18-20]. The most frequently cited theories are the following:

1. The open-systems framework of Richard Hofferbert [21];
2. An approach involving rational actors within institutions, as developed by Elinor Ostrom and her colleagues - the IRA approach [22];
3. The "advocacy coalition" framework, as recently developed by Sabatier [23].

The general lifecycle of policy making consists of the following steps: articulating opinions, comments in connection with the draft policy, followed by the processing of comments. Based on the processing the policy maker get a feedback, whereas the periodicity of feedback lasts from one-time to continuous feedback, summary, evaluation. Considering the feedback, policy will be fine-tuned. The iterative solution may result the optimal policy solution, where one of the optimality criteria is the continuous monitoring of the policy effects, embedded into the process. Finally, not only the policy in question will be monitored, but also the policy making process. This latter self reflected feature of the solution will lead to step forward to the direction of social learning.Policy modeling implies the application of methods and tools from a broad range of disciplines and integrates various lines of research and the state–of- the-art.

Policy modeling is the method through which a precise model may be used to help understand and evaluate available policy options. These models can be of various natures, including: statistical, econometric, systems dynamics, micro-simulation and agent-based simulations. Each technique has different advantages and disadvantages, making different compromises in order to help bridge the gap between the complexity of the environmental/sociological/economic/political situations that exist and the decisions and understanding of the policy advisor that has to face these. Such modeling is mainly a technical affair and has been largely in the hands of specific experts, working with inputs and evaluations coming from policy makers. The main policy modeling approaches are the following [15]:

- Behavioral modeling
- System dynamics
- Multi-level and micro-simulation models
- Queuing models or discrete event models
- Cellular automata
- Agent-based social simulation
- Theory of complexity

Some governments do not yet have any policy making or modeling tools, but many models are starting to be used across governmental and non-governmental

organisations, to support policy making also in developing countries. Modeling is used extensively in health, education, criminal justice environment, urban planning, transport etc. The traditional constitutional framework of policy-making suggests that politicians make policy and public servants implement it. In practice, this offers a limited understanding of policy-making, which fails to recognize the many competing factors which shape the way policy is formulated, implemented and evaluated.

In the last fifteen years the policy making process is in a permanent process of being (more and more) technologically-enhanced. Despite many successes, especially in the domain of e-government, policy-making process is still suffering from many early-detected problems: inefficiency, non-transparency, not-citizen-driven, etc. The main cause of the problem has been related to the unavailability of official data, low engagement of citizens and very rigid (inflexible) policy making processes. However, nowadays we are experiencing dramatic transformation in several domains that can influence the policy making process:

- Data has become Big (Data), i.e. big (and integrated) enough to provide the proper context for analysing a problem and /or a situation of interest.
- Information has become Open (Data), enabling creating awareness about any change in a wider context.
- Knowledge has been evolved in the wisdom of the crowd, by allowing that everyone can contribute to the resolution of a problem.
- Participation has started to be gamified, by fostering true engagement in any kind of (personal or collective) activities.
- From intuition-driven into data-driven policy making.

Policy making process is usually not driven by data, but mainly by so called "political intuition" and experiences (in the context of political goals). This has resulted in the policy not addressing the real needs of all citizens' groups. Big and Open- Data analytics will make them visible.

- From rigidly-defined into open, anticipatory and agile policy making process

Policy making processes are implemented as slow, well-structured workflows, without many possibilities to influence them in a bottom-up fashion. Crowdsourcing and gamification will enable that everyone will be better motivated to participate and each opinion will be taken into account for the final solution. It will result in a more flexible process that is sensing early indicators for changes and continuously improving the quality of the resulting regulations.

Several researches in the 1990s focused on the architectural issues of policy systems, and researches cited the importance of enforcement [25-26]. Marriott [25] abstracted the policy life-cycle as editing, distributing and deleting policies. Avitable [27] expanded this lifecycle approach, and differentiated a development phase (refinement, deploy, distribution, test), and an operational phase (activation/deactivation, enforcement, removal). These approaches have the common characteristic of focusing on technological issues. Zhang et al [24] developed the policy lifecycle model for system management, concentrating on internal organisational policies, and policy

enforcement, identifying elements of the lifecycle as management objectives, policy definitions, policy deployment and policy enforcement.

The research took also into account different approaches meant to evaluate policy impact. There are many typologies currently used, and they mainly vary according to the specific policy to be evaluated, as well as according to the moment in which they are carried out: ex ante, monitoring and ex post. Ex ante analysis is a "what if" analysis, meant to capture differences between the proposed reform(s) and the status quo. Monitoring analysis is a "what's happening" process, meant to collect feedback while a new measure is deployed. Finally, ex post analysis, seeks for results achieved, given the initially fixed objectives. Some of the most common evaluation methods include cost-benefit analysis (CBA), an ex ante evaluation scheme which uses as measuring unit a monetary reference of the aggregate change in individual well being resulting from a policy decision, or also behaviour models, techniques designed to shed light on the potential distributional impacts of policies, that do not currently exist, but that might exist in the future. Furthermore another important classification distinguishes between macro- and micro-simulation models. Certain types of modeling problems are best dealt with using micro-simulation whereas for others an aggregate approach is more appropriate; micro-simulation models are computer models that operate at the level of the individual behavioural entity (person/family/firm), while aggregated approaches refer to explanatory variables already representing collective/National realities. Ex ante evaluation of policy impacts, the one using in most cases various typologies of simulation models, is usually carried out by experts, and still not so widely used among National governments, except for some Anglo-Saxon countries. Policy monitoring, as well as ex post evaluation, are sometimes carried out by governmental structures, but more commonly by university departments.

Another key issue in policy making processes is risk assessment. NAO [28] suggests six key questions which public administrations might ask them to assess whether they have a sound approach to managing risk. This is particularly important where initiatives require coordination between a number of parts of the same organisations or with other organisations. A possible solution for preventing risks to undermine public policies deployed are Early Warning Systems [15], which showed their potential benefit also in policy modeling. Early Warning Systems bases on one or more models of how the phenomenon monitored behaves. The model is being used to show what is likely to happen next. These models can range from simple to very complex systems. Early Warning Systems can base on quantitative and qualitative approaches using for instance either a more formal forecasting oriented approach through e.g. simulations or a more informal foresight approach using e.g. scenarios.

The involvement of citizens/stakeholders is vital in the policy making process. This involvement is starting to take place through innovative approaches, based on direct participation of stakeholders, often convoyed through IT means. Edelenbos [29] defines interactive decision making as a way of conducting policies whereby a government involves its citizens, social organizations, enterprises, and other stakeholders in the early stages of the policy-making process. The difference with more traditional public policy procedures is that parties are truly involved in the development of policy proposals, whereas in classic opportunities of public comment, citizen and interest group involvement only occurred once the policy proposal had been developed. Obviously active involvement of stakeholders brings along also a series of problems,

because in most cases it is quite different from traditional decision-making procedures, so separate organisational provisions have to be developed in order to conform to these innovative decision-making procedures. Evaluating the connection of this new policy practice with existing decision making and the elaboration of guidance supporting this new practice is definitively important.

3 Policy Modeling Solution through Social Learning – Centralab Policy Modeling Framework

This section gives an overview about our policy modeling solution, which was developed in Centralab project (http://www.centralivinglab.eu) (Figure 1). CentraLab solution is based on "Living Lab" approach and incorporates the two novelties discussed in previous section, namely data-driven and agile policy making. Data – driven feature means that policy making process is supported by data collected from various other sources; while agility means the real-time support of policy maker through visualization and interpretation of data. In this ICT driven model, technology brings infrastructures into real-life contexts to enable a "co-design" process with end users. This method supports faster time to market and more customised solution for R&D results, as demonstrated by the 212 Living Labs in the ENoLL network (www.openlivinglabs.eu). The specific objective of CentraLab is to apply the Living Lab approach transversally across a broad range of policy fields relevant to Central European regional development, constructing a multi-level governance network for a trans-national Central European Living Lab. It thus contributes to "enhancing the

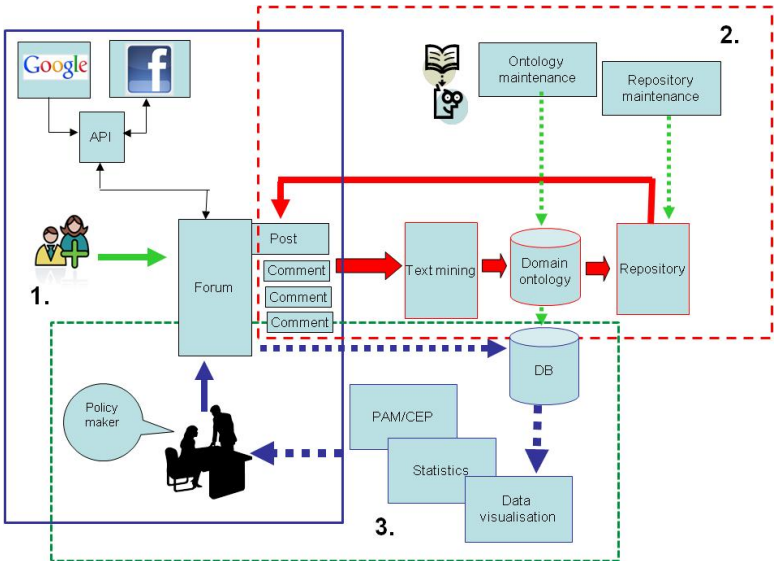

Fig. 1. General overview of Centralab solution

framework conditions for innovation", particularly in the organisational and policy dimensions of a new methodological research infrastructure. Centralab aimed to develop a new policy modeling framework that increases the knowledge economy component of regional development initiatives in a range of fields, amongst other in ecotourism, energy, micro-SME networks, environment & education, waste management and rural development.

Centralab solution map the general lifecycle of policy making process, it has three main blocks: portal, ontology learning block and interpretation block. Portal is used to support posting, issuing draft policies, comments and opinion articulation about policies and discussion with stakeholders. Ontology learning block helps to analyse and understand discussion and provide the context for the discussion. Interpretation block provide feedback and interpretation for policy makers. Next section will give a brief overview of the main building blocks of Centralab solution.

1. Portal is the online interface where interactions and discussions among the policy maker and the stakeholders (users interested in the specific topic, local inhabitants, domain experts etc.) can take place (area 1 in Figure 1). Discussions at the portal are initiated by the policy maker by describing a new or modified policy, asking for opinions, raising a specific topic etc and stakeholders can react to the proposal or to each others' opinions. Forum will be available also from popular social media solutions, e.g. from Facebook through API to broaden the community to be involved in the discussion, especially involvement of younger generation to the discussion. Besides textual inputs, the forum allows users to share and upload web links and media content. This component supports social learning through the contribution in common understanding of a problem, reach mutual agreement and take collective actions.

2. Ontology learning block (area 2 in Figure 1). In this part the analyses of the post and comments of the forum will take place, with innovative data-, web-, and text-mining solutions in order to identify emerging issues, "hot topics". Open source web and text mining solutions are applied (Weka). Web- and text-mining are enhanced with semantic technologies in the form of ontology learning. Ontology learning component is responsible for the semi-automatic building the ontology by learning from pre-processed information sources (the web- and text-mining output). The other role of ontology is to structure knowledge repository elements, which include policy related objects, sources from regulatory environment, laws, and economic reports. Studio, Corvinno's ontology-based knowledge repository will be used for this purpose. In those cases, when the automatic mapping is not successful, there is a need for human maintenance. The identified "hot issues" are mapped to the domain ontology in order to identify that content of the knowledge repository which is relevant to the topic. The purpose of the feedback to the discussion is to enrich the discussion, to draw the attention to the related but to the moment not mentioned dimensions, aspects, details, data, additional concept, etc. This way the discussion will be "automatically" moderated, trying to highlight as many as possible details, aspects of the problem. If no repository item found, a limited (in number) search is done on the web, illustrating the first few most relevant hits. This component enhances social learning through co-creation of knowledge, understanding of interdependence and complexity of the investigated problem.

3. Interpretation block. This part of the system is responsible for visualization and interpretation of the discussion and provides feedback to the policy maker (area 3 in Figure 1). Database is applied as an additional tier, to link the ontology learning process environment and the evaluation, visualization, and interpretation part, to the knowledge repository. Logging the discussion the system is able to evaluate the affectivity of the discussion in statistical terms. The statistical evaluation will give a reliable picture of number of participants, the distribution in time, the dynamic view of discussion, e.g. what are the hot topics, and how they change their relative importance in time or in connection with other subtopics. Visual analytics provides a comprehensive view of the ongoing discussion. In form of dashboards not only the policy maker but also the participants get summary feedback, since the dashboard is published on the portal, as well. The interpretation component is based on the complex event processing (CEP) principle. The policy KPIs are monitored and evaluated, the rule-based notification system notifies in a readable and understandable form the policy makers when and where to change, modify the policy, where to focus or pay more attention. Social learning in this component leads to acquisition of factual knowledge of policy maker, change of their attitudes, increase trust.

4 Realization

This section provides a technical background, description about the main components of the backend, which are a) social media portal b) ontology learning c) interpretation.

4.1 Social Media Portal – Forum

The base of the front-end is a Content Management System (CMS) called WordPress (thereinafter WP) which is able to help the web developers to create dynamic web sites and blog systems. WP is free, open source under GPL license and easy to use. It is written in PHP language, and maintained by a large community. WP's functionality is easy to extend with plug-ins which is also free and easy to deploy. There is lot of pre-coded plug-ins in ZIP format, which are also written in PHP, but own extensions can be also developed. WP websites can be designed with pre-designed templates based on CSS stylesheets, also many community maintained templates is available on the internet. The CMS provides the authentication, the authorization (AAA) on a secure HTTPS connection. Content and daily tasks are managed on a pre-defined administration panel which is provided by the WP engine. The popular social media services (like Facebook or Twitter) can be integrated with the WP, thus the CMS functionality can be extended by these third-party contents. The WP system runs under an Apache 2 web server which supports the appearance of the PHP based web sites. The web server is on Trustix 3.0 (Tikka Masala) Linux server provided by VMWare virtualization environment. In the background of WP there is a MySQL database for storing data on the logical level. Web Developers can access to the MySQL database through a so-called Phpmyadmin web based panel.

4.2 Ontology Learning Component

Ontology learning will include text mining application. In Hungarian case the linguistic algorithm will be written in JAVA and will run on an Apache Tomcat server (open source software implementation of the Java Servlet and JavaServer Pages technologies (tomcat.apache.org)). Because the services of the program can be accessed via web services, an Apache Axis 2 web service, SOAP and WSDL engine has to be run on the server providing the standardized XML-based definition of the functions and allowing the front-end application to use them. The following main text mining functions will be applied: stop-words filtering, stemming, n-gram generation. For stemming purposes the open source JMorph morphological analyser will be used. The morphological process produces a list of words given in dictionary format to be analysed with statistical methods. It is based on the frequencies of the words, which will be calculated during the process. Most relevant terms will be defined and sent to the Studio knowledge repository for further processing. After that Studio gives back the list of the related knowledge elements for the most frequent terms in a structured JSON format which is transferred to the front-end. If there is no relevant related knowledge element for the given term in the knowledge base, the text mining component makes an internet search using the Google's AJAX web service API and gives back the most relevant hits to the front-end in a JSON format.

4.3 Ontology Update

Domain ontology maintenance will be semi-automatic; ontology learning, folksonomies and social bookmarking will provide some automatic support for the update, which will be finalised by a human expert. Folksonomies and social bookmarking, which are decisive in social media, will have key roles in our approach as well. Folksonomy combines the words “folk” and “taxonomy”. It has been used to characterize the product which emerges from this tagging in a social environment. Social bookmarking sites such as Flickr, del.icio.us, and CiteULike have adopted folksonomic systems where users tag entities with keywords. In our solution tags, their initial structure and frequencies of occurrences will be extended from the users’ conversation by text mining solutions. Next step will be to derive ontologies from these folksonomies. Saab discussed the ontology of tags in his work [30], and Alves and Santanchè [31] describe folksonomized ontology building (attaching folksonomy’s tags (which come from ontology learning) to ontologies. We use their works as a starting point to develop our solution for the maintenance.

4.4 Studio – Knowledge Repository

Studio (http://abruzzo.corvinno.hu/studio-demo/index.html) is an ontology based online learning platform providing an elaborate but easy-to-use tool to represent a knowledge domain, discover the user`s knowledge gaps and access instant learning material. In its original form it consists of the Domain Ontology and the Repository that are the two major pillars of the whole solution and the Adaptive Testing Engine as well. The domain ontology provides the underlying structure of the content. The central element of content development and management is the Repository. Its content can be an image,

an article, short texts like a useful paragraph or a famous quote or even audio and video materials. The role of the Content Repository is to store and manage these content elements while maintaining a rich set of metadata describing the contained elements. Each content element can be described with Dublin Core metadata and other useful descriptors, like tags or categories. Adaptive Testing Engine is responsible for determining the knowledge level of the test taker as precisely as possible with as low number of questions as possible. Studio is widely used in higher education in Corvinus University of Budapest (in BSc business informatics and business intelligence teaching, in MSc IT audit teaching) and in CISA exam preparation courses held by Corvinno and Hungarian ISACA. In our project Studio is customised and its ontology-driven content management functionality is applied.

4.5 Feedback to the Forum

The results of the text-mining process arrive to the front-end in JSON format via web service call. The WP functions process JSON string and store the data in the MySQL database. The related contents list will be displayed on the front-end to the user.

Fig. 2. Centralab screenshot

The user in order to view the details of the related content, must click on the specific item of the list of knowledge objects, and the content related to the selected object will be shown in a pop-up window with a JQUERY function. During this event WP calls another web service which collects the selected knowledge item from the Studio repository.

5 Conclusion

Opinions about social learning role in participatory decision-making processes are various. Muro and her colleagues [32] conclude that the utility of the social learning

model for participatory processes still needs to be proven. They draw the attention that there is only limited evidence about the role of social learning in participatory processes and that the social learning model has a number of conceptual weaknesses. Centralab solution links between policy making process, method, and context (through ontology learning) and helps to reach shared views and a common understanding of the situation, which are an essential prerequisite for consensus and collective action. Considering the general overview of the model (figure 1) the technological impact categories can be linked to the model's different blocks or cycles and described as follows:

1. Centralab solution has a feedback strategy to policy maker about specific discussions: system fed back relevant knowledge material efficiently to a specific discussion and policy maker. Efficiency in this aspect means

- relevance and timeliness, i.e. how well the knowledge material that is fed back covers the actual topic of discussion and how well it follows the changes and fluctuations of the discussion during time;
- usability, i.e. if the participants of the discussion can truly absorb and use the new information that they get through the knowledge feedback for argumentation.

2. Semiautomatic ontology building: our research combined text mining and semantic technologies in ontology building. One of our solution main components is the repository feedback cycle. However, the effectiveness of this feedback in the project's model depends largely on the ontology based structure that is built up using the results of the text mining. Existing text mining solutions usually yield statistical results, in many cases combined with semantic analysis (e.g. emotional charge of found words). The innovation of our approach lies in the fact that, instead of only relying on the numerous expressions, it develops a semiautomatic method that uses the text mining results to build up an ontological structure of nodes and relations in order to better serve the knowledge feedback strategy.

As a summary of the above, we can say that our solution brings an important technological innovation in the way online discussions can be efficiently transformed into co-creative solution finding involving all the interested and affected stakeholders. Centralab solution provides an appropriate environment for social learning, amongst other it contributes in common understanding of a problem, support reaching mutual agreement and taking collective actions. It leads the acquisition of factual knowledge of policy makers, change of the citizens and policy makers' attitudes and increase trust between them. Future research will include the development of Centralab English version; fine-tuning of ontology learning process and its customization for additional domains (like tourism). English version of Centralab solution requires English text mining environment and its integration with the other Centralab components. In this step we plan to apply text mining components of Weka library and customize them. Another plan is to organize a real life test of Centralab solution; just now we are discussing with possible communities about the pilots.

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